

REMARKS

The Office Action dated November 30, 2005, has been received and carefully noted. The above amendments to the claims, and the following remarks, are submitted as a full and complete response thereto.

Claims 1-12 are currently pending in the application, of which claims 1, 3, 5, 7, and 9 are independent. Claims 1, 3, 5, 7, and 9 have been amended to more particularly point out and distinctly claim the invention. No new matter has been added, and the amendments do not raise new issues that would require additional consideration and/or search. Claims 1-12 are respectfully submitted for consideration.

Interview Summary

The Examiner granted an interview on February 8, 2006. Applicant thanks the Examiner for the courtesies extended to Applicant's representative during the interview. Applicant's representative and the Examiner discussed the cited references compared with claim recitations. The Examiner indicated that, as the claims were being understood, the feature of "controlling a density distribution of molten resin at a nose portion of the screw" was not understood to be limited to "while moving the screw backward." Applicant has amended claims 1, 3, 5, 7, and 9 to clarify this feature of the claims.

Rejections under 35 U.S.C. 103(a)

Claims 1-4 and 9-12 were rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 4,879,077 of Shimizu et al. ("Shimizu") in view of U.S. Patent No.

5,194,195 of Okushima (“Okushima”) and further in view of JP 61-121921 of Akira (“Akira”). The Office Action took the position that Shimizu teaches most of the claim terms. The Office Action supplied Okushima to remedy some of the deficiencies of Shimizu by teaching “to move the screw backwards while rotating it after completion of the measuring process or the injection process and to control a density distribution of molten resin at a nose portion of the screw.” The Office Action supplied Akira to remedy other of the deficiencies of Shimizu by teaching “to retract the screw at a constant backward speed while rotating it.” Applicant respectfully submits that the claims recite subject matter that is neither disclosed nor suggested in the cited references.

Claim 1, upon which claim 2 depends, is directed to a method for controlling an injection molding machine including a heating cylinder and a screw disposed in the heating cylinder, and performing a plasticization/measuring process and an injecting process. The method includes defining a synchronization ratio S of a rotation speed of the screw to be 100% when the position of a flight thereof does not apparently move relative to a constant backward speed V of the screw. The method also includes moving the screw backwards at the constant backward speed V while rotating it after completion of the measuring process or the injecting process. The method further includes controlling a density distribution of molten resin at a nose portion of the screw while moving the screw backwards. A rotation speed R of the screw during the backward movement is given by multiplying the rotation speed R , which is expressed by the equation, $R = \text{backward speed } V/\text{pitch } P$ of the flight, by an arbitrary synchronization ratio Sx .

Claim 3, upon which claim 4 depends, is directed to a method for controlling an injection molding machine including a heating cylinder, a screw disposed in the heating cylinder, a first driving source for driving the screw in an axial direction, a second driving source for rotating the screw, position detecting means for detecting an axial position of the screw, rotation-speed detecting means for detecting the rotation speed of the screw, and a controller for controlling the first driving source and the second driving source dependent on the detecting signals transmitted from the position detecting means and the rotation-speed detecting means, and performing a plasticization/measuring process and an injecting process. The method includes defining a synchronization ratio S of a rotation speed of the screw to be 100% when the position of a flight thereof does not apparently move relative to a constant backward speed V of the screw and controlling a density distribution of molten resin at a nose portion of the screw while moving the screw backwards. The controller moves the screw backwards at the constant backward speed V while rotating it after the completion of the measuring process or the injecting process. A rotation speed R of the screw during the backward movement is given by multiplying the rotation speed R , which is expressed by the equation, $R = \text{backward speed } V/\text{pitch } P$ of the flight, by an arbitrary synchronization ratio S_x .

Claim 9, upon which claims 10-12 depend, is directed to a method for controlling an injection molding machine in order to control the movement of a molten resin in a heating cylinder of the injection molding machine, the injection molding machine including a screw arranged within the heating cylinder to be rotatable and to be linearly movable and having a flight of a pitch P , the molten resin being moved in a forward feeding direction during a

plasticization process and an injecting process. The method includes linearly moving the screw backwards relative to the forward feeding direction of the molten resin at a constant backward speed, controlling a density distribution of molten resin at a nose portion of the screw while moving the screw backwards, and simultaneously rotating the screw in the forward feeding direction at a rotation speed corresponding to the constant backward speed, after completion of the plasticization process or the injecting process.

Applicant respectfully submits the combination of Shimizu, Akira, and Okushima does not disclose or suggest all of the elements of any of the presently pending claims.

Shimizu relates to a control method of an injection molding machine. Shimizu describes that a screw 2 is rotated in the reverse direction to the rotational direction in the measuring process at the same time when screw 2 is moved forward in the injection process. The apparent position of ridge 2h or groove 2d of screw 2 is set to become stationary in a predetermined position in the heating cylinder. Shimizu also describes calculating a reverse rotational speed, or r , of screw 2 using the equation $r \geq Vs/L$, where Vs is the injection (forward moving) speed of screw 2 and L is the pitch of screw 2.

Akira relates to the control of metering speed of an injection molding machine. Akira describes that the retreating speed of a screw upon metering plasticized material is controlled by direct feedback control in the case of injection molding. Rotation of screw 12 is driven by a screw driving motor 18 and molten resin is transferred by the rotation of the screw into the fore part of screw cylinder 10 while screw 12 is retreated by the pressure of the resin. A retreating speed detector 28 detects the actual retreating speed of the screw. The detected speed and an objective retreating speed are operated in a relational operator 32 to control the

rotation of screw 12 in a direction to eliminate the difference between the speeds at operator 32.

The Office Action admits that the combination of Shimizu and Akira does not disclose “controlling a density distribution of molten resin at a nose portion of the screw” as recited by claims 1, 3, and 9. The Office Action has supplied Okushima to address this limitation.

Okushima is directed to a method of controlling injection molding machine by use of nozzle resin pressures. In Okushima, after the dwell pressure application step, the nozzle switching valve 12 is closed. Then, after the resin pressure is detected at the upstream side of the nozzle, back pressure is applied to the resin at the front end of the screw feeder by controlling the injection cylinder. Thus, Okushima merely discloses a technique to control resin pressure at the front end of the screw to be uniform so that resin pressure will be the same for each shot. That is to say, Okushima is designed to enhance the reproducibility of each shot. Accordingly, Okushima controls the resin pressure in the metering or pre-load step, as can be seen in Figure 2B and column 5, lines 11-40 of Okushima.

Although Okushima describes that the density of the resin stored at the front end of the screw feeder will be uniform, Applicant respectfully submits that Okushima describes that condition only when the nozzle switching valve 12 is closed, as explained at column 3, lines 18-30 of Okushima.

However, Applicant respectfully submits that when the nozzle switching valve 12 of Okushima is closed, the dwell pressure application step cannot be performed, which is why the nozzle switching valve 12 is closed only after the dwell pressure application step, as

explained at column 3, lines 44-52 of Okushima. Accordingly, Applicant respectfully submits that Okushima does not teach “to control a density distribution of molten resin at a nose portion of the screw” while moving the screw backwards, and thus Okushima does not remedy the deficiencies of Shimizu and Akira.

In contrast to Okushima’s mere capability of making each shot similar to the other shots, certain embodiments of the present invention may also be able to make each shot uniform within the shot. This intra-shot uniformity may be accomplished by controlling during screw reversal, as opposed to by controlling during metering as described by Okushima. Thus, certain embodiments of the present invention may not only have the benefits that Okushima describes, but the additional benefit of maintaining the uniformity of the molten resin within one shot.

During the interview, the Examiner indicated that claims 1, 3, 5, 7, and 9 (claims 5 and 7 are specifically addressed below) do not clearly indicate that “to control a density distribution of molten resin at a nose portion of the screw” is to occur while moving the screw backwards. Claims 1, 3, 5, 7, and 9 have been amended to clarify this feature.

Claims 2, 4, and 10-12 depend from claims 1, 3, and 9 respectively and recite additional limitations. Accordingly, it is respectfully submitted that each of claims 2, 4, and 10-12 recites subject matter that is neither disclosed nor suggested in the cited references. Accordingly, it is respectfully requested that the rejection of claims 1-4 and 9-12 be withdrawn.

Claims 5-8 were rejected under 35 U.S.C. 103(a) as being unpatentable over Shimizu in view of Okushima. The Office Action took the position that Shimizu teaches most of the

claim recitations. The Office Action supplied Okushima to remedy the deficiencies of Shimizu by teaching “to move the screw backwards while rotating it after completion of the measuring process or the injection process and to control a density distribution of molten resin at a nose portion of the screw.” Applicants respectfully submit that the claims recite subject matter that is neither disclosed nor suggested in the cited references.

Claim 5, upon which claim 6 depends, is directed to a method for controlling an injection molding machine in order to perform a resin plasticization/measuring process and an injecting process. The injection molding machine includes a heating cylinder and a screw having a flight of a pitch P, the screw being arranged within the heating cylinder. The method includes defining a synchronization ratio S with reference to a rotation speed R and a constant linear backward speed V of the screw, the synchronization ratio S being equal to 100% when the flight does not apparently move while the screw is rotated and linearly moved backwards, the synchronization ratio S being smaller than 100% when the flight moves backwards while the screw is rotated and linearly moved backwards, the synchronization ratio S being greater than 100% when the flight moves forwards while the screw is rotated and linearly moved backwards. The method also includes controlling a density distribution of molten resin at a nose portion of the screw while moving the screw backwards. The method further includes controlling the screw to linearly move backward at a selected synchronization ratio S_x and simultaneously rotate after completion of the plasticization/measuring process or the injecting process. A selected rotation speed R_s of the screw is given by $R_s = (V/P) \times S_x$.

Claim 7, upon which claim 8 depends, is directed to a method for controlling an injection molding machine in order to perform a resin plasticization/measuring process and an injecting process. The injection molding machine includes a heating cylinder, a screw having a flight of a pitch P and arranged within the heating cylinder, a first driving source for driving the screw in an axial direction, a second driving source for rotating the screw, a position detecting device for detecting an axial position of the screw, a rotation-speed detecting device for detecting the rotation speed of the screw, and a controller for controlling the first and the second driving sources in response to detecting signals transmitted from the position detecting device and the rotation-speed detecting device. The method includes defining a synchronization ratio S with reference to a rotation speed R of the screw and a constant linear backward speed V of the screw, the synchronization ratio S being equal to 100% when the flight does not apparently move while the screw is rotated and linearly moved backwards, the synchronization ratio S being smaller than 100% when the flight moves backwards while the screw is rotated and linearly moved backwards, the synchronization ratio S being greater than 100% when the flight moves forwards while the screw is rotated and linearly moved backwards. The method also includes controlling a density distribution of molten resin at a nose portion of the screw while moving the screw backwards. The method further includes controlling the movement so that the screw is linearly moved backward at a selected synchronization ratio S_x and simultaneously controlling the rotation of the screw, after completion of the plasticization/measuring process or the injecting process. A selected rotation speed R_s of the screw is given by $R_s = (V/P) \times S_x$.

Accordingly, claims 5 and 9 both recite “controlling a density distribution of molten resin at a nose portion of the screw while moving the screw backwards.” As explained above with regard to the rejection of claims 1-4 and 9-12, the combination of Shimizu, Akira, and Okushima does not disclose or suggest at least this feature, and therefore the combination of Shimizu and Okushima also does not disclose or suggest at least this feature. As explained above with respect to claims 1-4 and 9-12, the combination of Shimizu, Akira, and Okushima does not disclose or suggest “controlling a density distribution of molten resin at a nose portion of the screw while moving the screw backwards.” Accordingly, it is respectfully requested that this rejection be withdrawn.

Claims 6 and 8 depend from claims 5 and 7 respectively and recite additional limitations. Accordingly, it is respectfully submitted that each of claims 6 and 8 recites subject matter that is neither disclosed nor suggested in the cited references. Accordingly, it is respectfully requested that the rejection of claims 5-8 be withdrawn.

Conclusion

For the reasons explained above, it is respectfully submitted that each of claims 1-12 recites subject matter that is neither disclosed nor suggested in the cited references. It is therefore respectfully requested that all of claims 1-12 be allowed, and that this application be passed to issue.

If for any reason the Examiner determines that the application is not now in condition for allowance, it is respectfully requested that the Examiner contact, by telephone, the

applicant's undersigned attorney at the indicated telephone number to arrange for an interview to expedite the disposition of this application.

In the event this paper is not being timely filed, the applicant respectfully petitions for an appropriate extension of time. Any fees for such an extension together with any additional fees may be charged to Counsel's Deposit Account 50-2222.

Respectfully submitted,


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Enclosures: Petition for Extension of Time